MITSUBISHI ELECTRIC

Changes for the Better

Microgrid Research at Mitsubishi

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2005-6-17

MITSUBISHI ELECTRIC CORPORATION

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Micro Grid in Japan

(1) Necessity or purpose

Necessity or Purpose	America	EU	Japan
Reliability of power Supply	○		
Reduction of investiment in plant and equipment Reduction of erection period	○		
Reduction of energy cost	○	○	
To keep environmental condition (ex. Reduction of Co_2)		○	○
To ensure diversity of energy supply			○
Power supply to island and/or remote place		○	△

Microgrid in Japan

(2) Future plan of Japanese government for spread of renewable energy resource

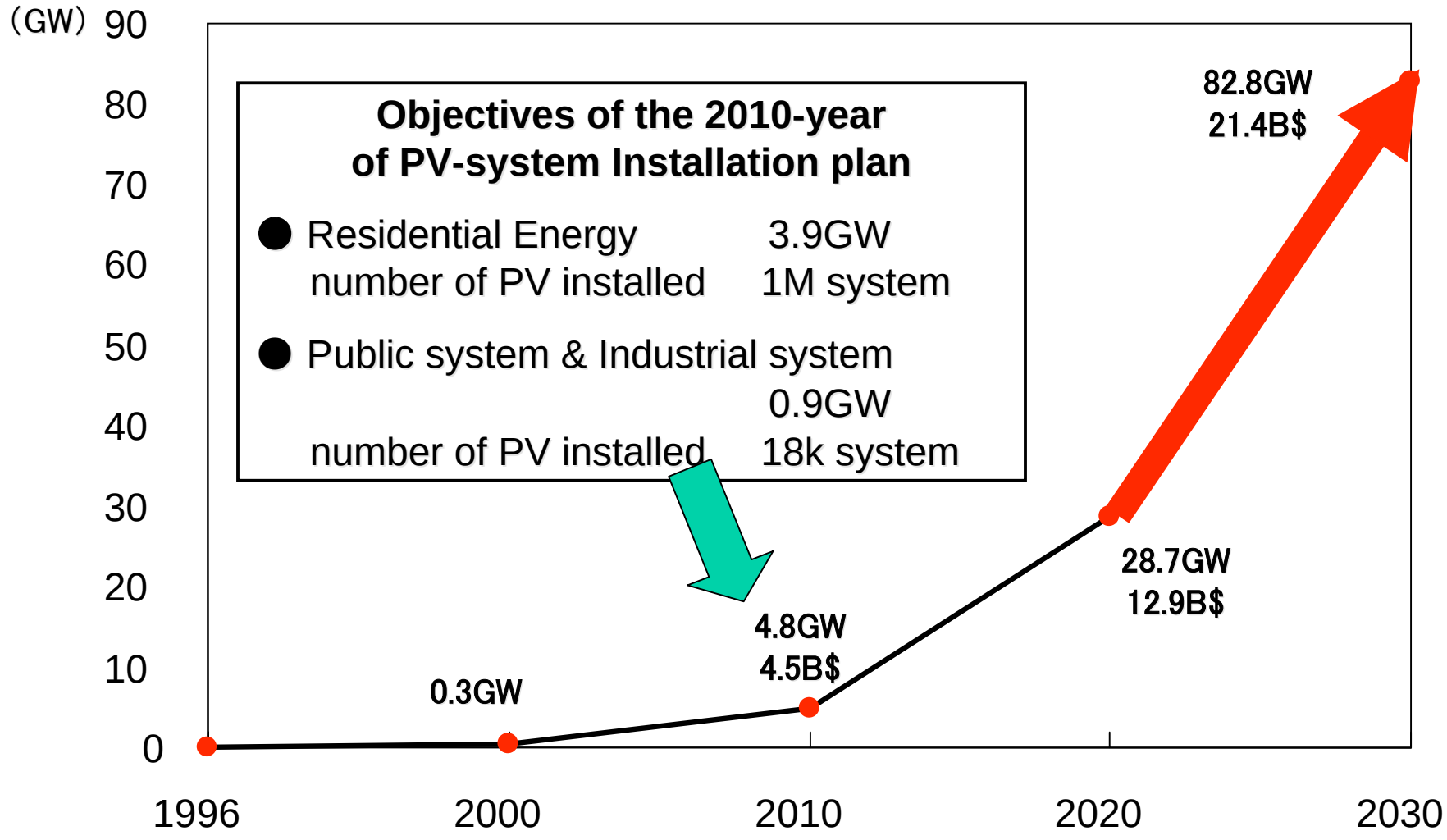
Generator \ Year	2000	2010
PV	330MW	4.8GW
WT	144MW	3.0GW
Generation by biomass waste	70MW	330MW
Generation by combustible waste	1.0GW	4.2GW

(3) Support Program

- METI(Ministry of Economy, Trade and Industry) and Ministry of Environment support to develop micro grid
  - Budget of METI 120M$ / this year
  - Budget of Ministry of Environment 15M$ / this year

Microgrid in Japan

(4) Objectives of the 2030-year of PV-system Installation plan



Melco's Activity

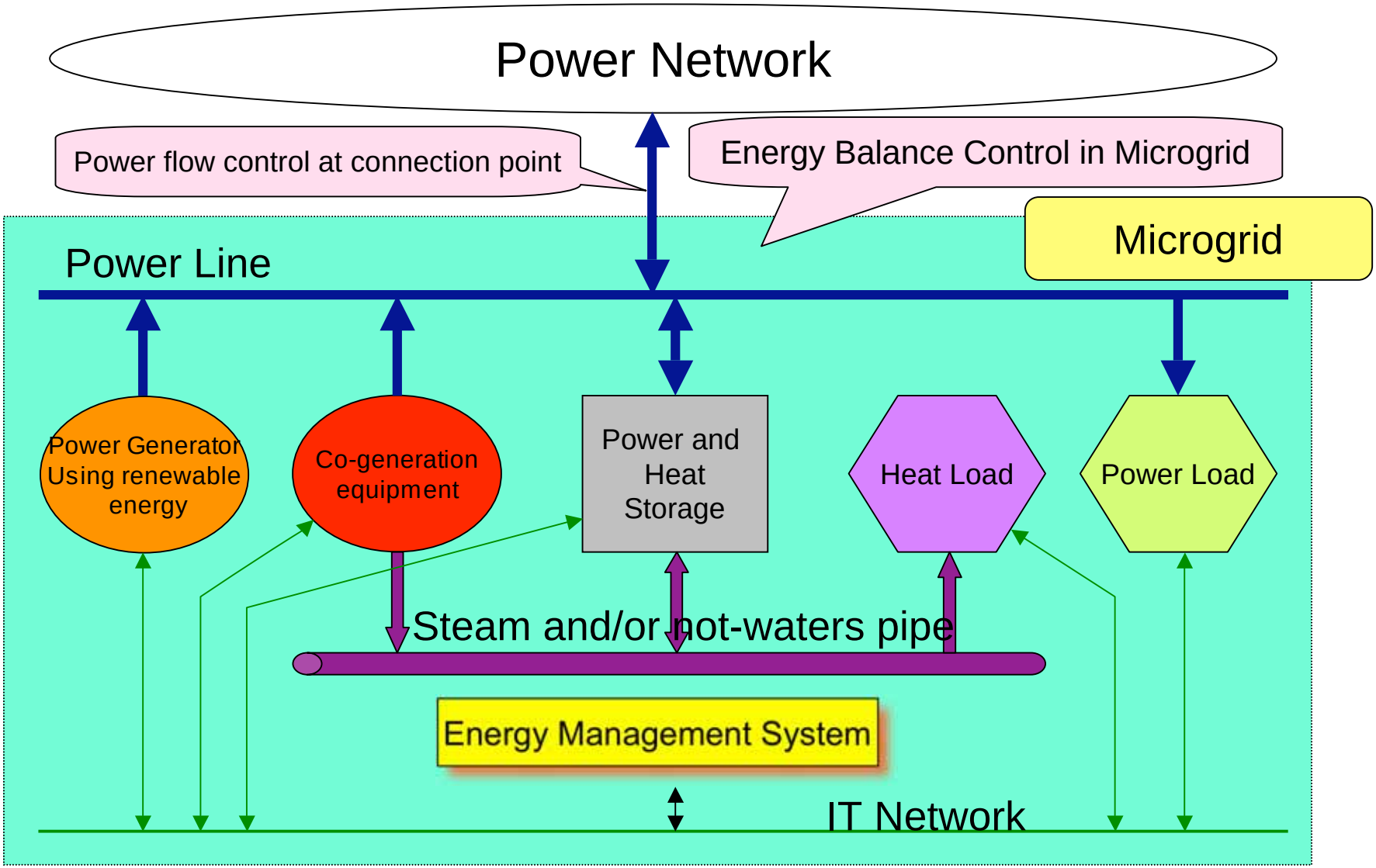
(1) Melco classfies micro grid into 3 groupes

	Generation capacity	Fuel	Application	Market size
Large Scale	1000MW	heavy oil and/or coal	Industrial complex	10-20
Middle Scale	100MW	heavy oil and/or coal renewable energy	Industrial park	100
Small Scale	10MW	renewable energy	-small area network -condominium -island and remote area	3000

(2) Four jobs are in progress

	Sponsor	Existing state
Microgrid project in Hsinchiang Uighur Autonomous Region, China	METI	Under operation
Microgrid project for Aichi EXPO	METI	Under operation
Microgrid project in Hachinohe-city	METI	Under production in Melco's works
Microgrid project for condominium	Ministry of Environment	This program starts at this April
Microgrid project in Oki-island	METI	Feasible study starts at this April

(3) Basic system configuration of Microgrid



(4) Operation Mode of Microgrid

	Feature	Note
Connection Mode	1.Main purposes are -reduction of energy cost - reduction of environmental burdens 2.Generator operation :P-θ(orP-Q) control	When blackout occurs in power network, Operation mode of microgrid changes from connection mode to island mode.
Island Mode	1. Main purposes is to keep -reliability of power supply -power quality 2.Generator operation :F-V (or P-V) control	———

P: Active power Q: Reactive power θ: Power facter
F: Frequency V: Voltage

Melco's Activity

(5) Melco's products

- Renewable energy technology

PV

FC

WT

Biomass

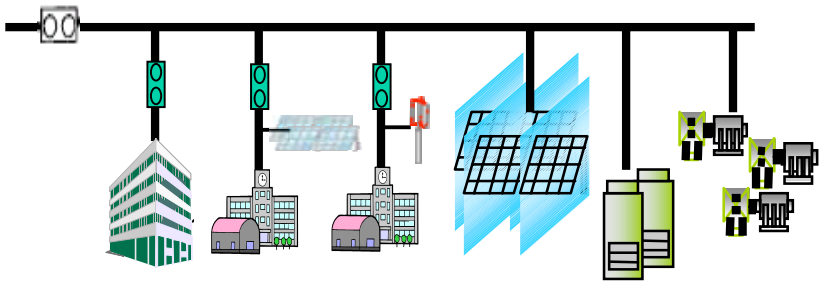
- Power electronics

Inverter

Device

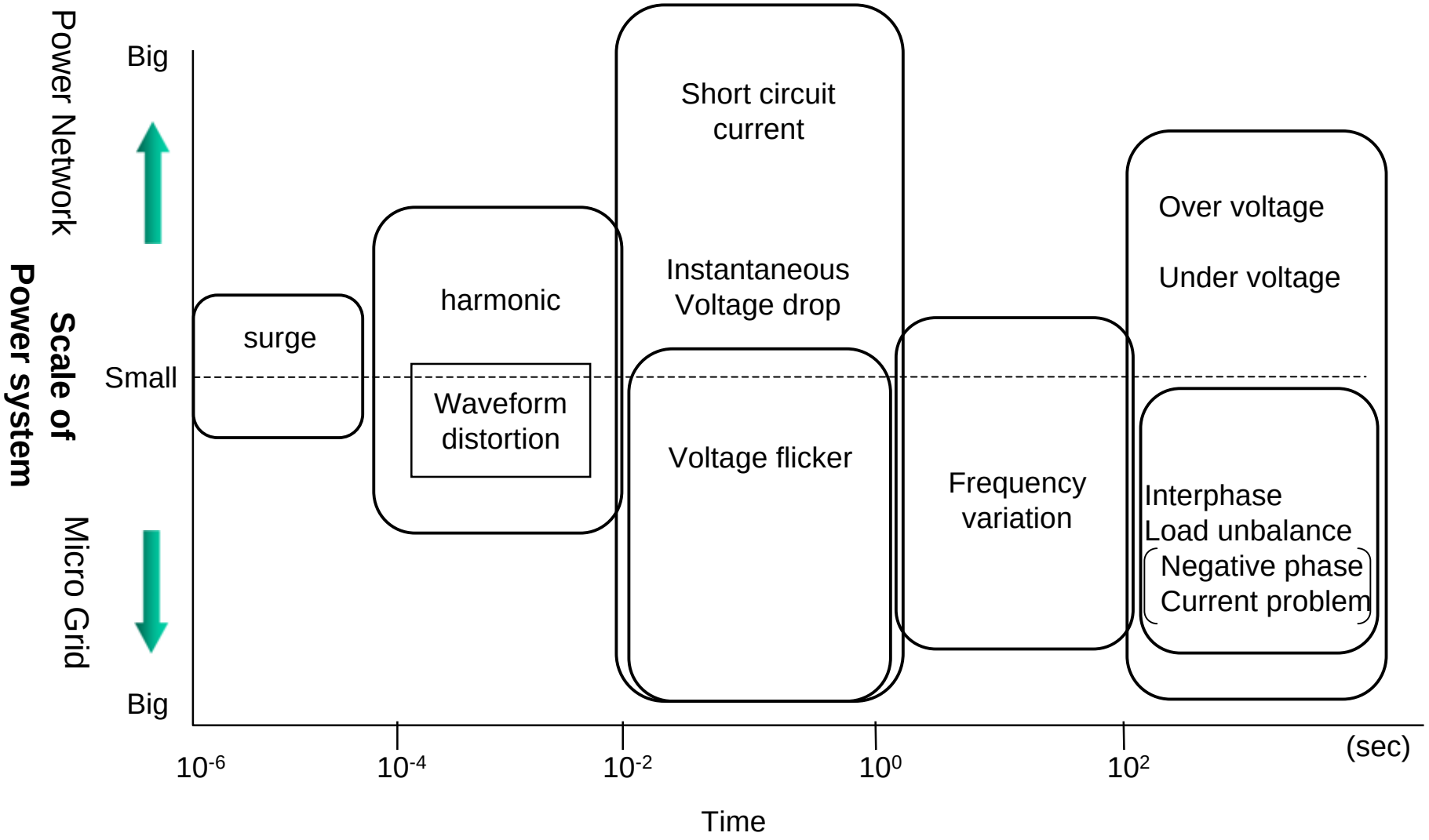
- EMS

Microgrid

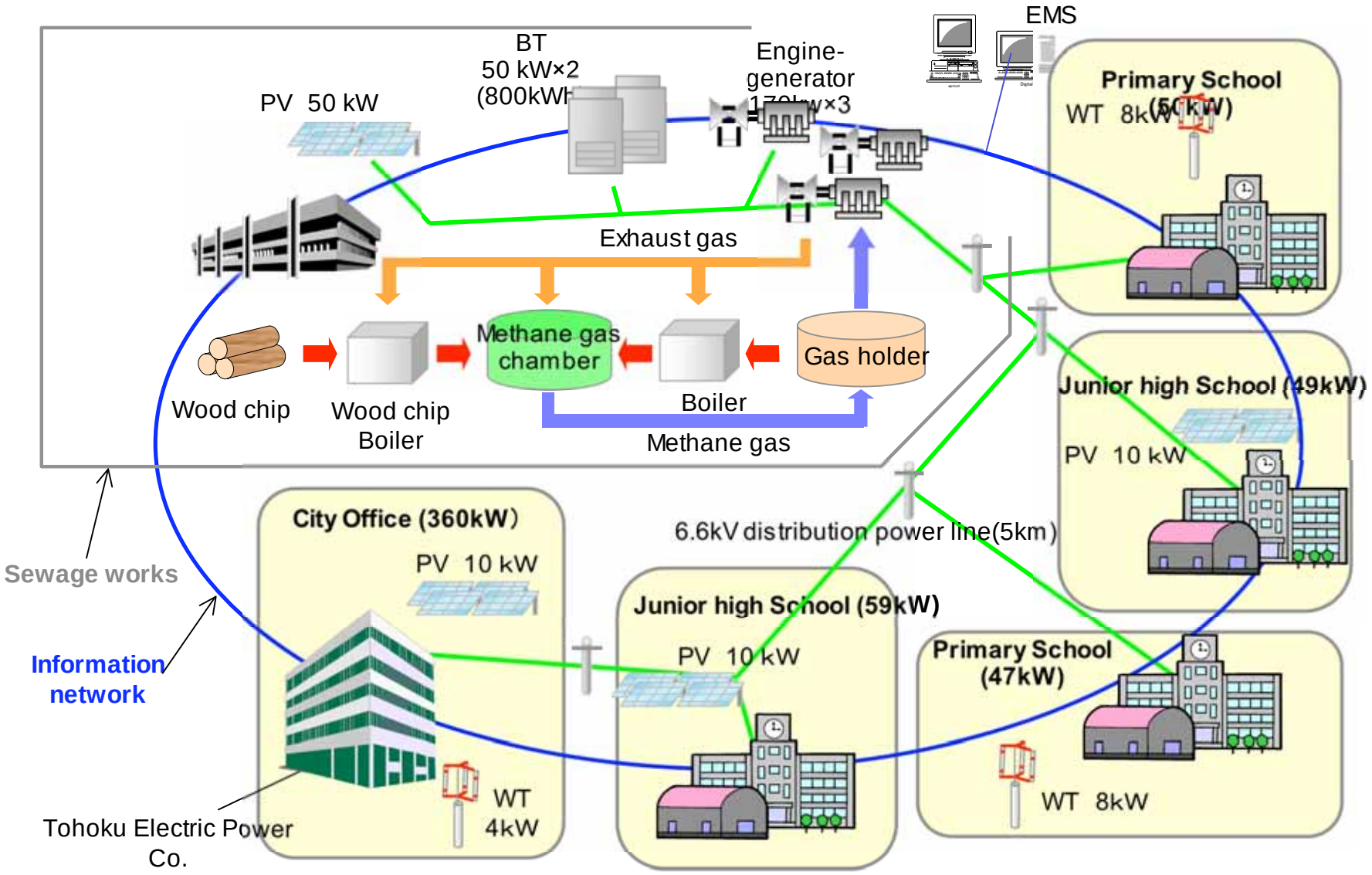


Quality of power system

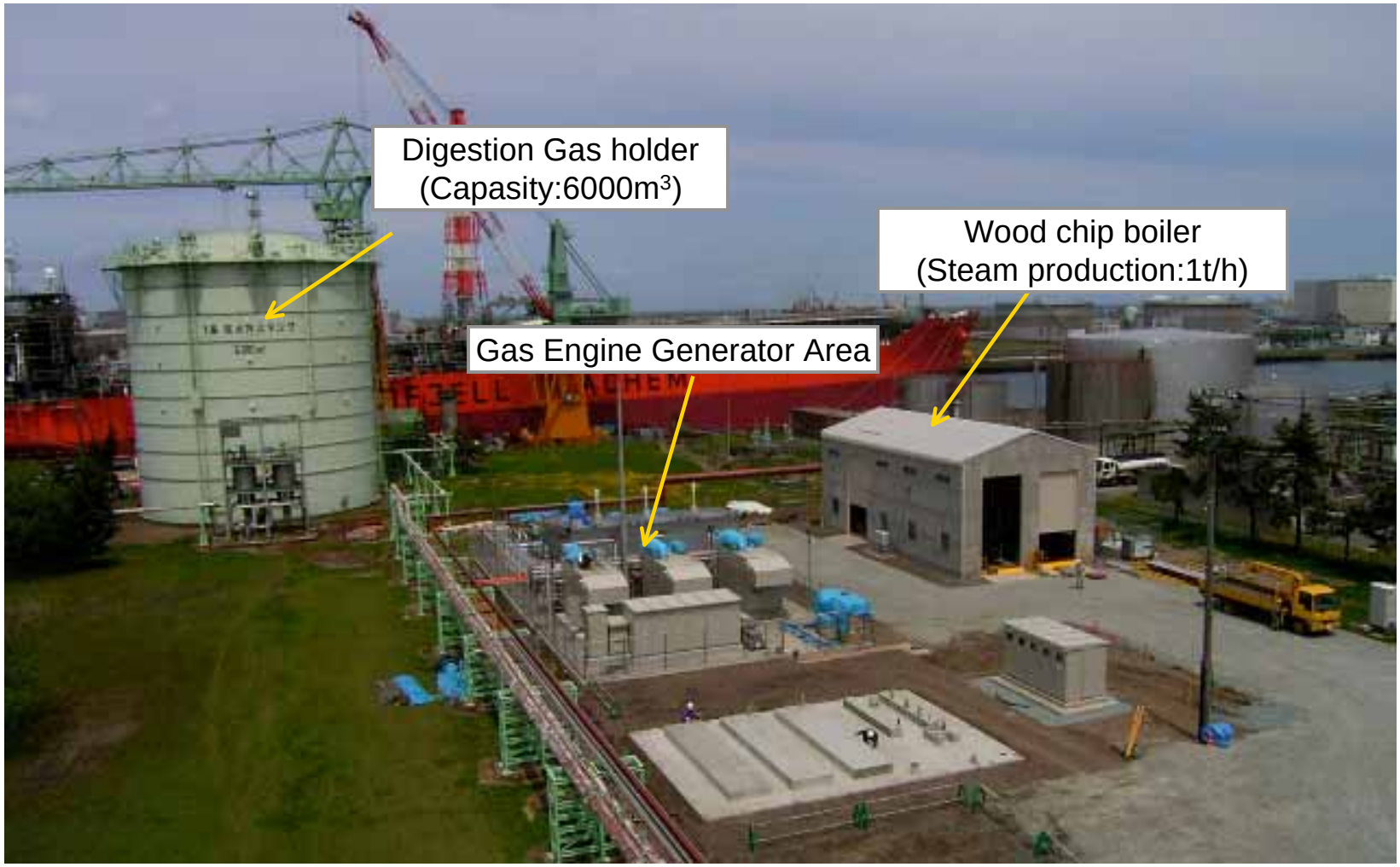
Changes for the Better



(1) System Configuration



(2) Overview of Generation System at Sewage works

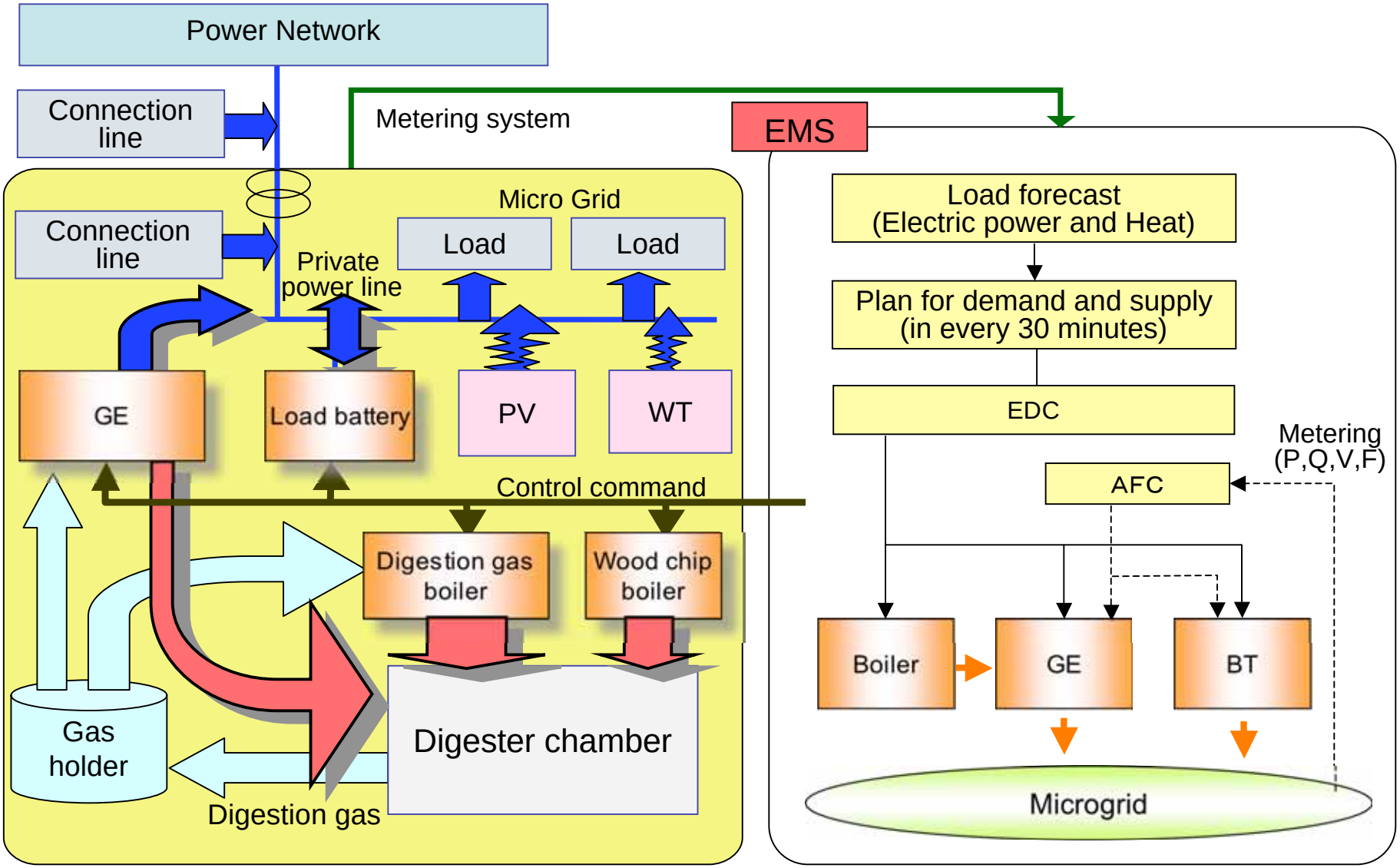


(3) Renewable Generators

10kW PV System
(installed at roof of city office and Junior high school)

8kW WT Generator
(installed at primary school)

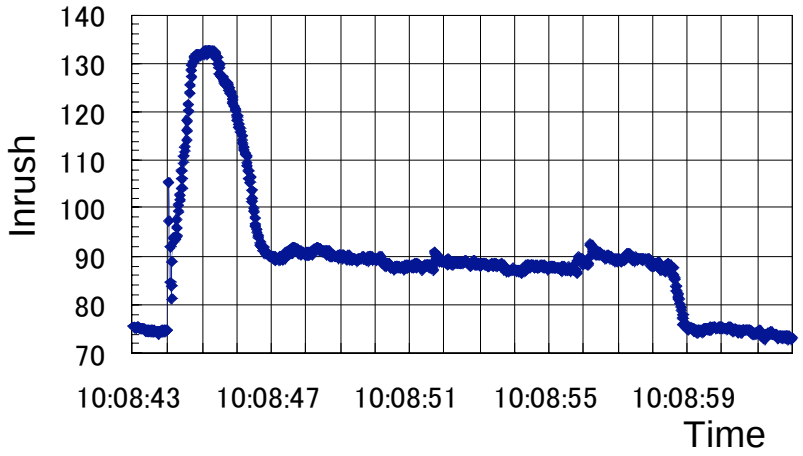
(4) Energy Management System



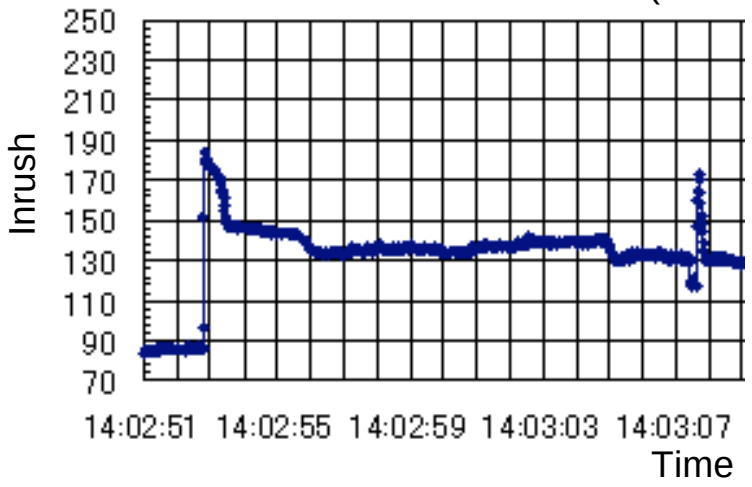
(5) Power System Analysis

(A) Inrush current of Induction Moter

Inrush current for elevator (IM:15kW)

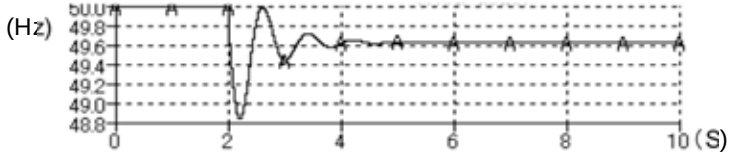


Inrush current for Air condition (IM:37kW)

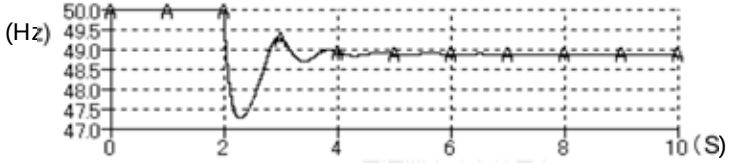


(B) Frequency drop caused by inrush current

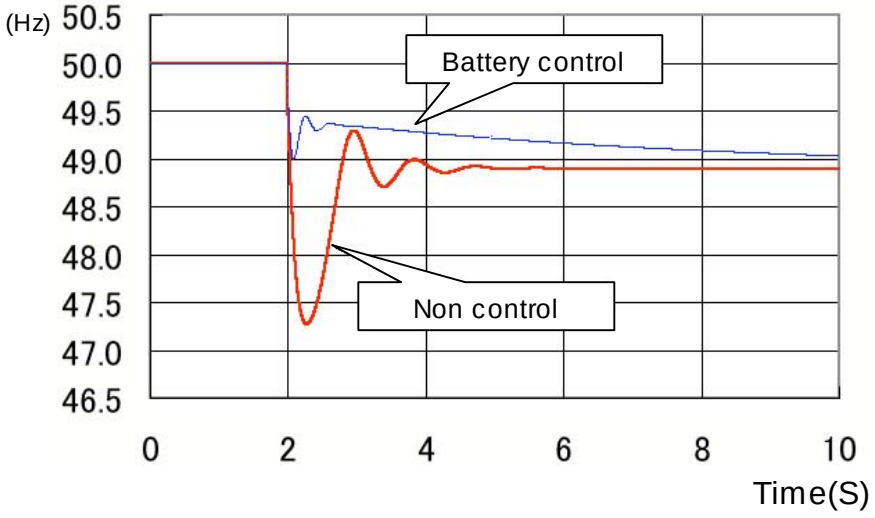
(a) Induction Moter for elevator



(a) Induction Moter for Air condition



(C) Effect of BT control



Microgrid in Hsinchiang Uighur Autonomous Region, China

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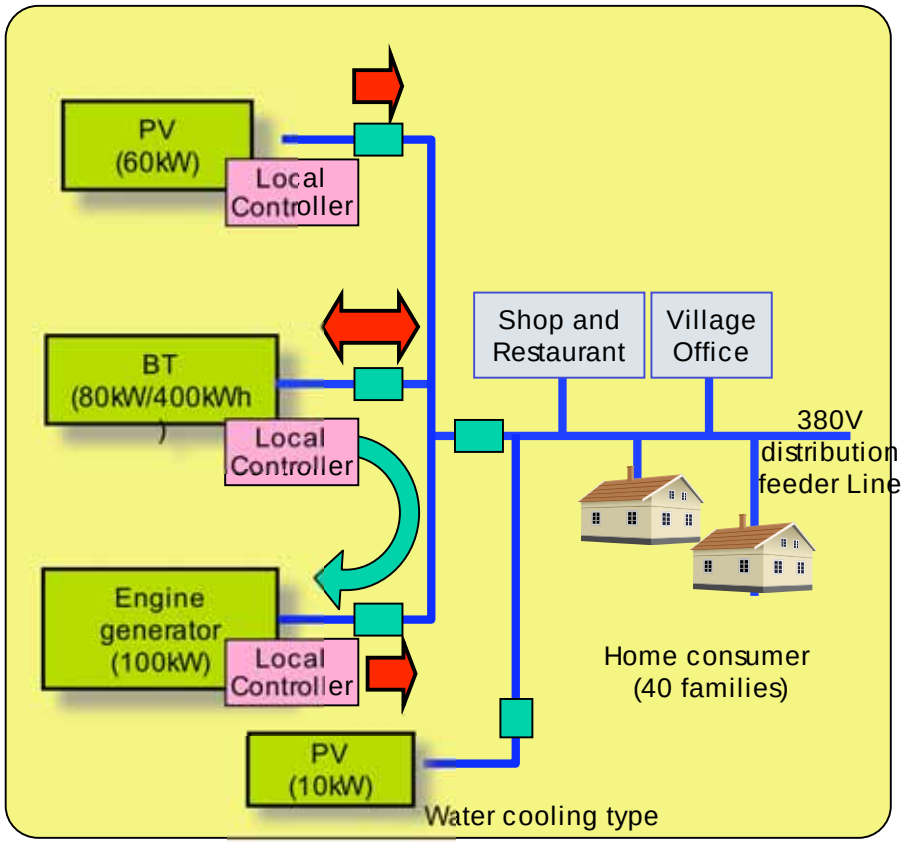
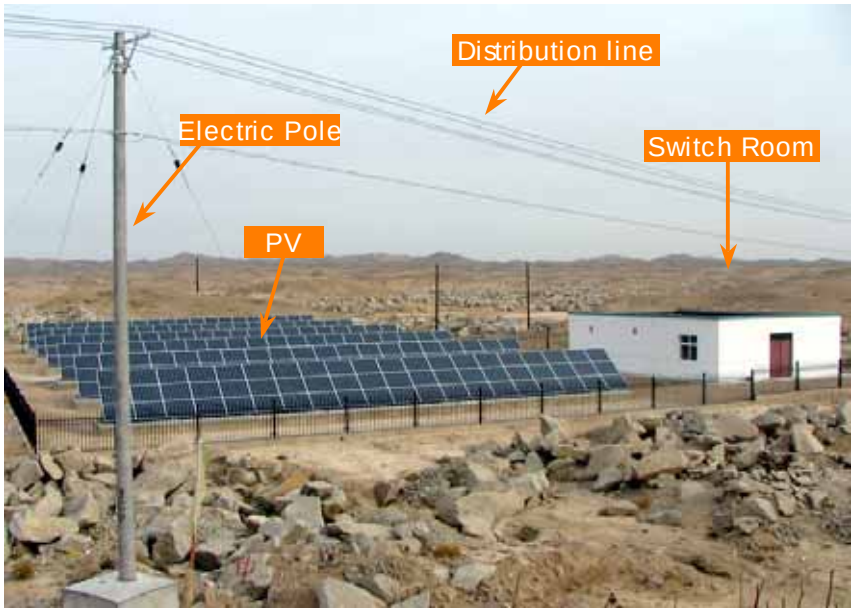
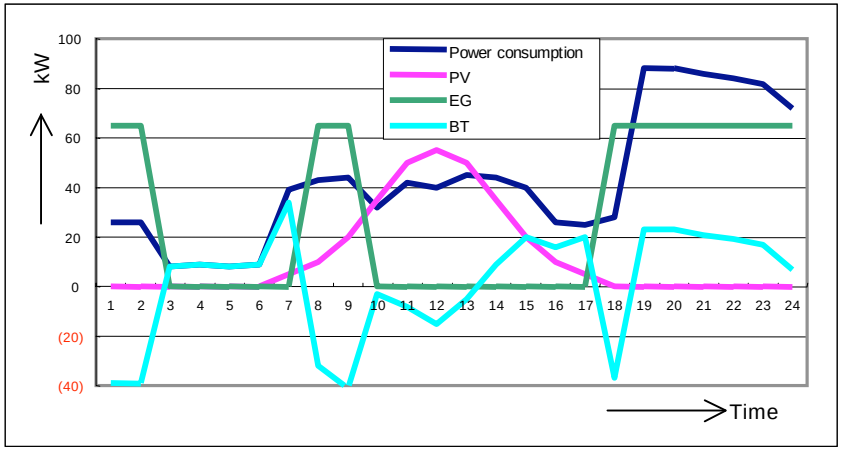


1. Electric Power Generation
   - Engine Generator 100kW
   - PV 70kW
   - BT 80kW (400kWh)
   - 250kW
2. Peak Load 90kW (at night time)
3. Distribution feeder 380V /500m

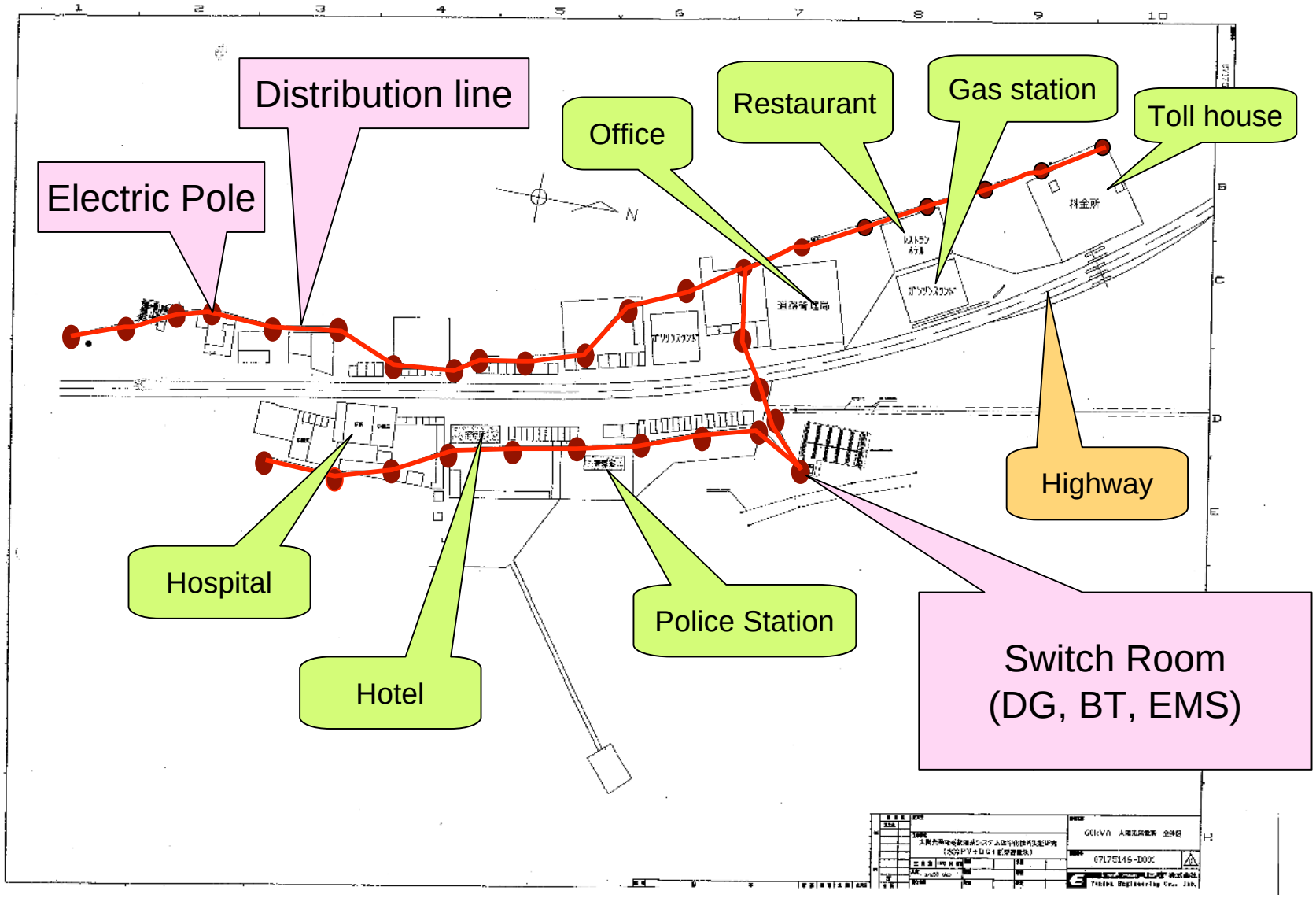




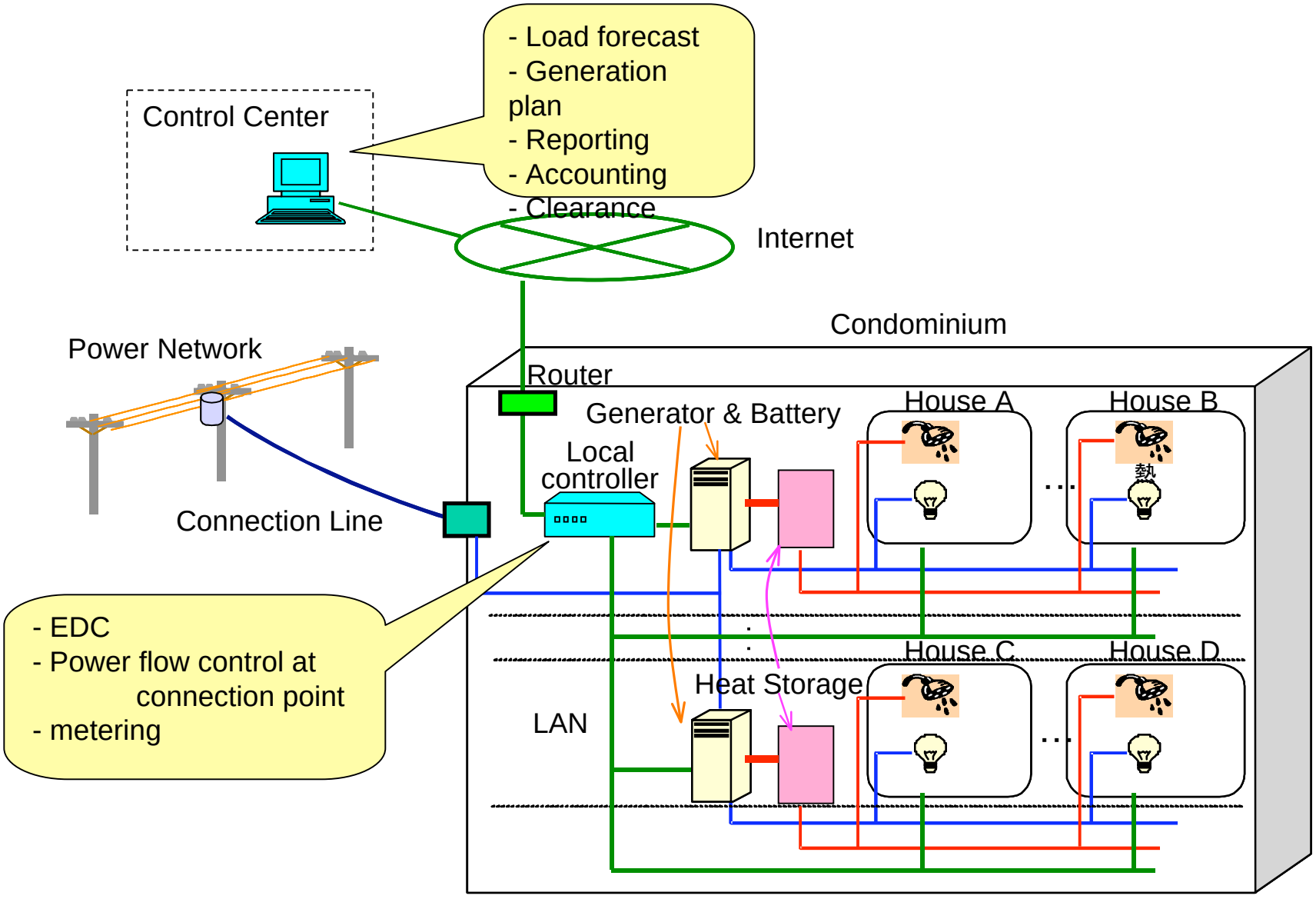
Load and Generation curve

Microgrid in Hsinchiang Uighur Autonomous Region, China

Changes for the Better

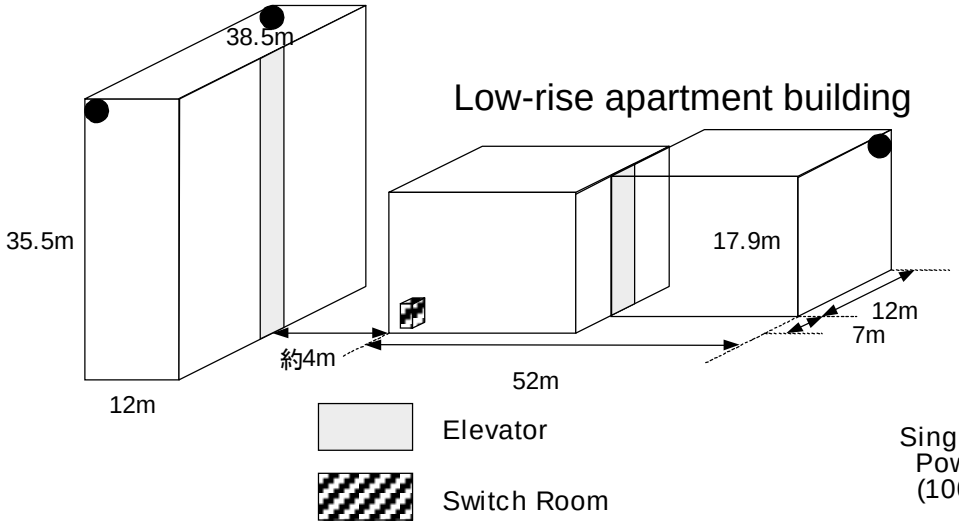


(1) System Configuration

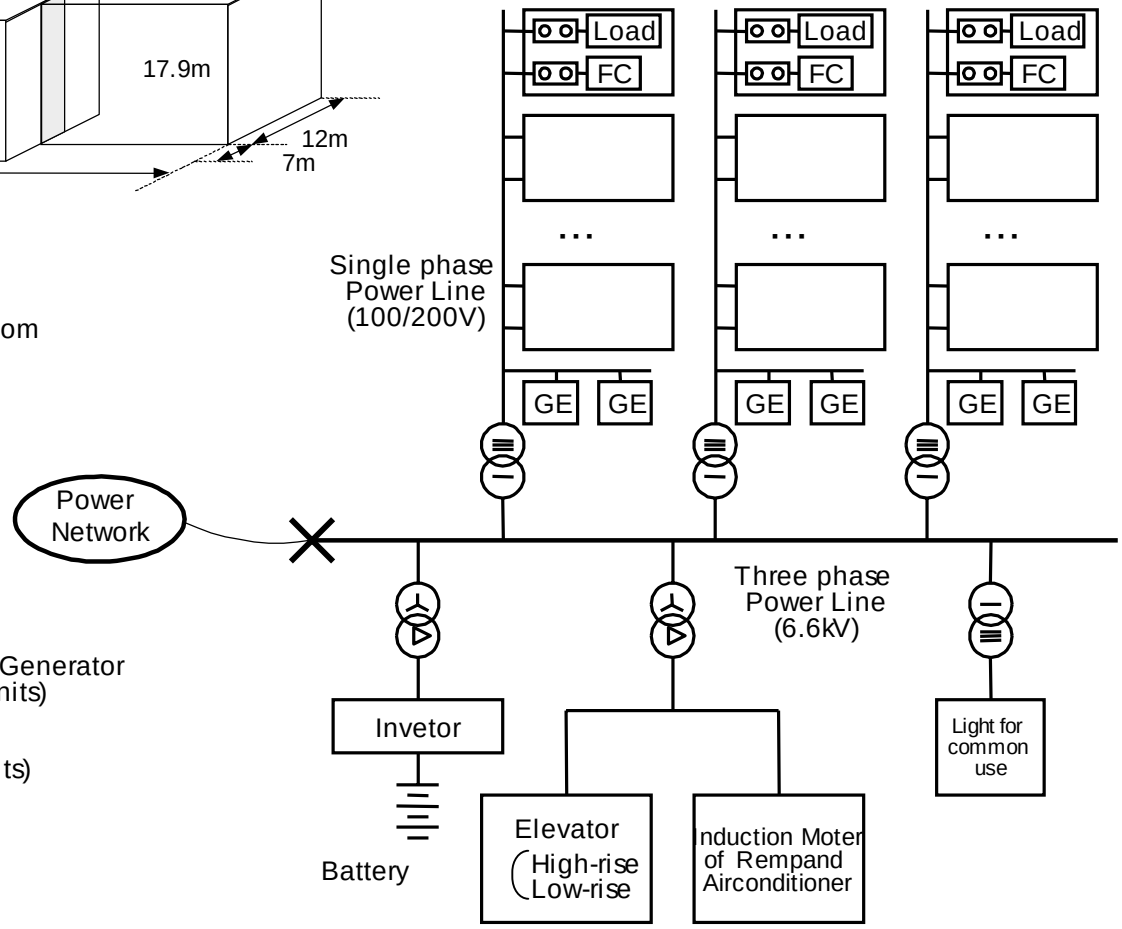


(2) Model condominium

High-rise apartment building



Power network in condominium



(Note) GE:Single Phase
Gas Engine Generator
(10kW x 12units)

FC:Fuel Cell
1kW x 100units)